SOUTHERN FOREST EXPERIMENT STATION

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SITE INDEX TABLES FOR SHORTLEAF PINE IN THE OZARK HIGHLANDS OF NORTHERN ARKANSAS AND SOUTHERN MISSOURI

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Field guides are presented for estimating site index on each of the three major soil groups in the Ozark Highland Province: limestone-dolomite, sandstone, and fragipan soils. Factors utilized vary by soil groups but include aspect, township, slope shape and depth to pan, with adjustments for hardwood competition. Tabular predictions were within ± 3 feet of measured site values on 83 percent of 41 limestone-dolomite sites, 81 percent of 37 sandstone sites, and 91 percent of 42 fragipan soils.

Additional keywords: *Pinus echinata*, fragipan, hardwood competition.

This note presents tables for estimating shortleaf pine index[2] on the three major soil groups of the Ozark Highlands in Arkansas and Missouri. Site index estimates are based on aspect, slope shape, depth to fragipan, and degree of oak and hickory competition—information that can be determined readily in the field.

Site index values were derived from equations developed by the authors and reported earlier (Graney and Ferguson 1972). Application of the tables should be restricted to the area indicated in Figure 1, where the data for deriving and testing the equations were collected.

Field Measurements Needed

Hardwood competition.—Experience in another area (Ferguson and Graney 1972) indicated that the number of oak and hickory stems and sprout clumps within 40 feet of the plot center could be in frequency classes which were positively correlated with measured loss-on-ignition (organic content) values. A similar relationship between oak and hickory stems and sprouts was also observed for the Ozark Highland sites. These frequency classes essentially reflect prior land use and presence or absence of hardwoods during the life of the stand. For management application, effective control of

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[2] Site index for shortleaf pine is the total height in feet of dominant and codominant trees at 50 years of age.

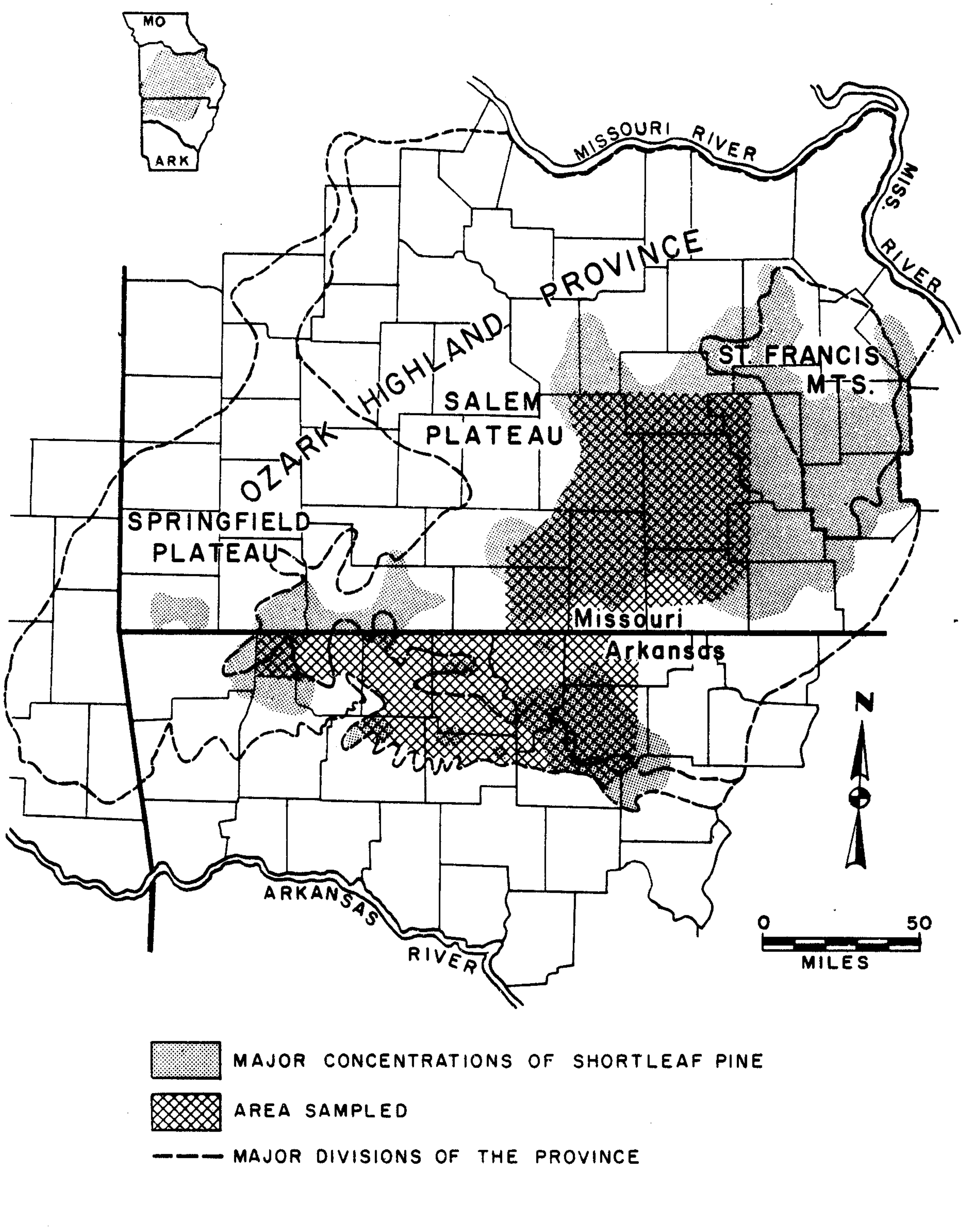

Figure 1.—*Location of area sampled within the Ozark Highlands of Arkansas and Missouri.*

competing hardwoods during establishment and early life of pine stands will reduce or eliminate the negative influence of hardwood competition on height growth of the pine. However, levels of hardwood competition have been included as modifiers in these site index tables to quantify the relative effect of hardwood competition on pine height growth.

Slope shape.—Determine whether the general configuration of the slope in the immediate vicinity of the plot is (1) convex, where the general area tends to have a rounded surface sloping away from the plot proper; (2) linear, sloping but neither rounded nor cup shaped; or (3) concave or cupshaped, where the general area tends to drain inward toward the plot. Site index increases as slope shape changes from convex through linear to concave.

Aspect.—This indicates the dominant slope-facing direction, measured in degrees azimuth on sites with slopes of 3 percent and greater. Ridge and upper slope positions with slopes of less than 3 percent are considered as neutral. For each soil grouping, northeast facing slopes are the more productive shortleaf pine sites, while southwest exposures are the poorer sites. Northwest and southeast exposures are intermediate in productivity between the better and poorer slope aspects.

Depth to pan.—Site index increases with greater depth to pan within the range of 14 to 28 inches. Fragipan layers may aid tree growth by reducing movement of water down through the profile during wet periods. Watt and Newhouse (1973) indicated that the soil above fragipan layers will hold about the same volume of available water as the upper 36 inches (zone of maximum rooting) of the nonpan soils. Thus the range in productivity for the pan soils would be similar to that of the nonpan soils, but the limiting factor would be the effective soil moisture storage capacity above the fragipan layer.

Township.—Climatic changes with latitude would seem to explain this variable. Length of growing season, together with average annual and May-September precipitation, increase from north to south throughout the Province.

Construction and Testing of Tables

Separate analyses of the three major soil groups resulted in individually unique prediction equations. Site index tables were constructed for each soil group by semigraphical extrapolation of the appropriate prediction model. These tables were developed by holding all but a single predictor variable constant in the equation and computing site indexes for various levels of the free predictor. After this step was completed for each predictor variable, the data were plotted and curves drawn. Curve values were then incorporated into the tables.

The Tables

Predicted site index for the limestone and dolomite soils are provided in Table 1. The table predicts within a rather narrow range of site index, varying from 53 to 65 feet—a difference

Table 1.—*Predicted site index in feet at age 50, by aspect, township and slope shape for Arkansas and Missouri limestone-dolomite soils*[1]

Township	Slope shape	Aspect (degrees azimuth)[2]				
		0–80	326–359 81–115	296–325 116–145	261–295 146–180	181–260
T13N–T19N	Concave	65	64	63	62	61
	Linear	63	62	61	60	59
	Convex	61	60	59	58	57
T20N–T26N	Concave	63	62	61	60	59
	Linear	61	60	59	58	57
	Convex	59	58	57	56	55
T27N–T33N	Concave	61	60	59	58	57
	Linear	59	58	57	56	55
	Convex	57	56	55	54	53

[1] For existing stands adjust predicted site index as follows: Where the number of oak and hickory stem and sprout clumps within a 40-foot radius of plot center is between 76 and 150, drop 2 feet; where the number exceeds 151, drop 4 feet.

[2] Ridge and upper slope sites with slopes of less than 3 percent are considered as neutral or within the 296–325 and 116–145 azimuth range.

of only 13 feet. However, when maximum adjustment for hardwood competition is applied, the range is extended to 17 feet. Site indexes were estimated with this table on 41 Arkansas and Missouri limestone and dolomite pine sites which had not been included in the analyses or development of the table. On all but one plot, the tabular value was within ± 5 feet of measured site index, while 83 percent of the sites were estimated within ± 3 feet.

Table 2 covers sandstone-derived soils. Although the site index range for the sandstone soils was greater than that for the limestone-dolomite soils, both tables predict within the same site index range. Thirty-seven additional sandstone soil sites were used to determine the accuracy of the table and, again, only one prediction exceeded the measured value by more than 5 feet. Site index on 81 percent of the sites was estimated within ± 3 feet of measured values.

Table 3 covers the pan soils. The 16-foot span of predicted site index in this table was slightly greater than those of the other two soil groups. On the 42 additional sites used to test site index estimates, none of the predictions missed by more than 5 feet and 91 percent were within ± 3 feet of the measured site index values. Although not significant in fitting the model and thus not included in the site prediction table, the observed relationship between site index and competing hardwoods on the pan soils was generally similar to that indicated in Tables 1 and 2.

The values in the tables do not predict over as wide a range in site index as individual soil group equations, primarily because they were derived from averages. Consequently the tables will tend to overestimate site index potential on very poor sites and will underestimate site indexes on particularly good sites (table 4). However, field application indicates that the tables should be accurate enough for classifying site potential into at least poor, medium and good categories.

Table 4.—*Ranges in predicted site index for original soil group equations and derived site index tables*

Soil group	Predicted site index range			
	Equation		Table	
	High	Low	High	Low
Limestone-dolomite soils	69	45	65	49
Sandstone soils	66	48	65	49
Fragipan soils	67	47	65	50

Table 2.—*Predicted site index at age 50, by aspect and slope shape for Arkansas and Missouri sandstone soils*[1]

Slope shape	Aspect (degrees azimuth)[2]				
	0–80	326–359 81–115	296–325 116–145	261–295 146–180	181–260
Concave	65	63	61	59	57
Linear	63	61	59	57	55
Convex	61	59	57	55	53

[1] For existing stands adjust predicted site index as follows: Where the number of oak and hickory stem and sprout clumps within a 40-foot radius of plot center is between 76 and 150, drop 2 feet; where the number exceeds 151, drop 4 feet.

[2] Ridge and upper slope sites with slopes of less than 3 percent are considered as neutral or within the 296–325 and 116–145 azimuth range.

Table 3.—*Predicted site index in feet at age 50, by aspect and depth to pan for Arkansas and Missouri pan soils*

Depth to pan (inches)	Aspect (degrees azimuth)[1]				
	0–80	326–359 81–115	296–325 116–145	261–295 146–180	181–260
26–28	65	64	63	62	61
23–25	62	61	60	59	58
20–22	59	58	57	56	55
17–19	56	55	54	53	52
14–16	53	52	51	50	49

[1] Ridge and upper slope sites with slopes of less than 3 percent are considered as neutral or within the 296–325 and 116–145 azimuth range.

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